

A banner for the Agricultural Outlook Forum. It features a collage of images: a man in a cap, a woman with arms raised, a drone, wind turbines, a hand holding a tablet, and a young plant in soil. The text 'Agricultural Outlook Forum' is centered in a dark grey box.

Agricultural Outlook Forum

Alfalfa & Forage Dynamics in the Current Agricultural Landscape

February 24, 2023

Robin Newell

Presenting As:

Chairman Emeritus, National Alfalfa & Forage Alliance

And

Alfalfa Products Director, S&W Seed Company

Main Points of Alfalfa Discussion

- What is Alfalfa and how does it differ from most other crops?
 - Where is alfalfa grown?
 - Value of the US alfalfa crop
 - How is alfalfa used in ruminant feeds? Or not?
 - What is the current status of Alfalfa hay stocks?
 - Drought Impact
 - Sustainability and soil fertility impacts
 - Water Quality and Soil Health Benefits
 - Other uses on the horizon?
 - How might climate change impact alfalfa?
 - NAFA's research priorities for alfalfa and ag policy
- Acknowledgment to USDA NASS -- Visual maps and data presented in the following slides are from the USDA NASS website unless noted otherwise.*

What is Alfalfa and how does it differ from most other crops?

- Perennial Forage Crop – *Medicago sativa*
- Alfalfa has an auto-tetraploid genome
- Obligate cross-pollinating; no homozygous inbreds
- C-3 photosynthesis, with a range of winter activity
- Deep root system that confers soil benefits
- Can last 20 years but productive stand life ~4-5 years
- Multiple harvests per growing season
- High yielding, typical range 15-22% crude protein
- Transgenic traits available



Where is alfalfa grown?

- 74 MM acres globally
- USA -- 16 MM acres; dairy hay & haylage, mixed hay, horse hay, organically produced hay crops, and export hay
- Canada – “Tame Hay” ~ 5 MM Acres
- EU
- Argentina & other LATAM
- MENA
- China
- Australia



Alfalfa is one of the largest crops in the U.S. and the world, utilized as a forage by livestock.

What's the current status of US alfalfa demand and utilization?

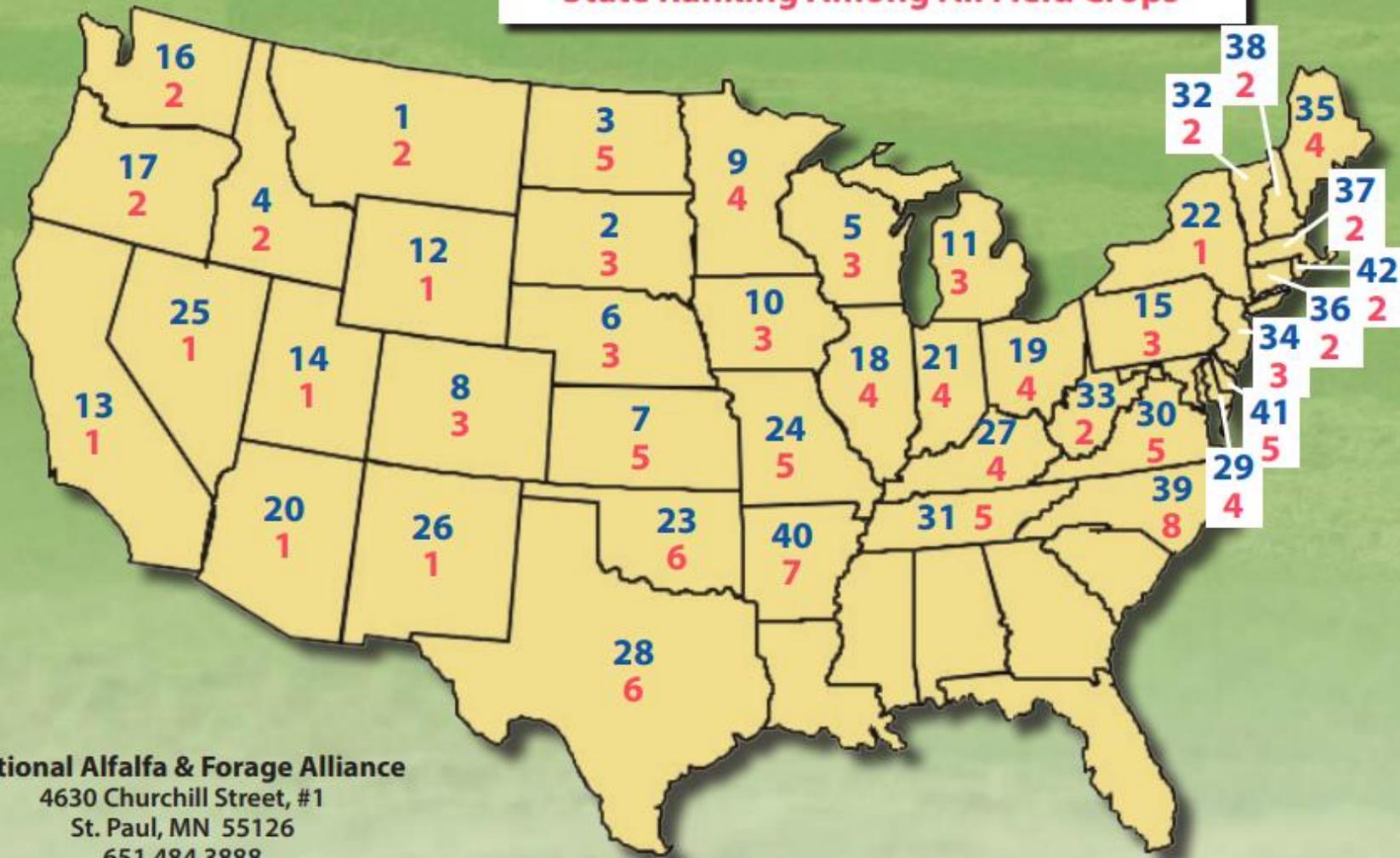
- Alfalfa hay is at record high prices currently
- High grain prices have put downward pressure on newly planted alfalfa acres
- Alfalfa acres in production can be de-coupled from annually seeded acres of alfalfa for a year or two, since alfalfa is a perennial crop
 - Average stand life exceeds seven years; aging stands become less productive
 - There can be a lag in newly seeded acres to 'catch up'
 - New seedings can be strongly influenced by factors like winter survival, irrigation water allocations and restrictions, planting season progression, etc.

- U.S. newly seeded acres recap in 2022
up 2% to 1.675MM acres
- Regional changes from 2021 to 2022;
PNW +11% Southwest (CA/AZ/NV) +2%
Northeast -19% Midwest - Flat Plains +5%
- Some of the most notable inc/dec are NY -33%, MN +35, WI -14%, KS -44%, ND +83%, OK +57%

- High quality alfalfa hay remains in high demand for domestic use and for export out of US
- Record prices have not slowed over the past 24-36 months
- Seeded acres in the West may return if available water improves to the point that alfalfa could be considered for crop rotation

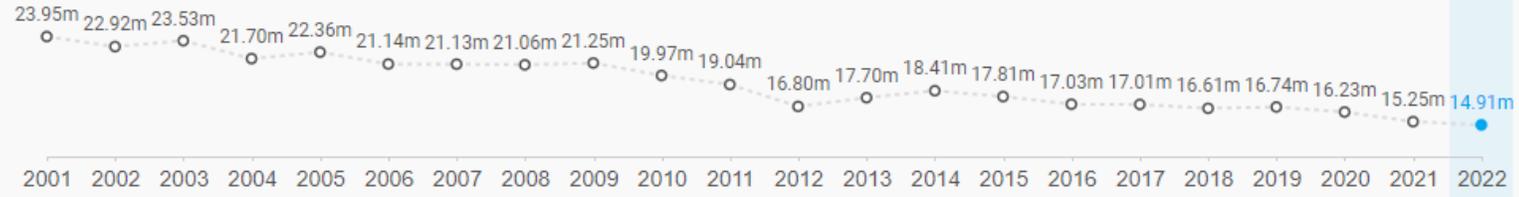
2022 Alfalfa Production Acreage

National Ranking
State Ranking Among All Field Crops



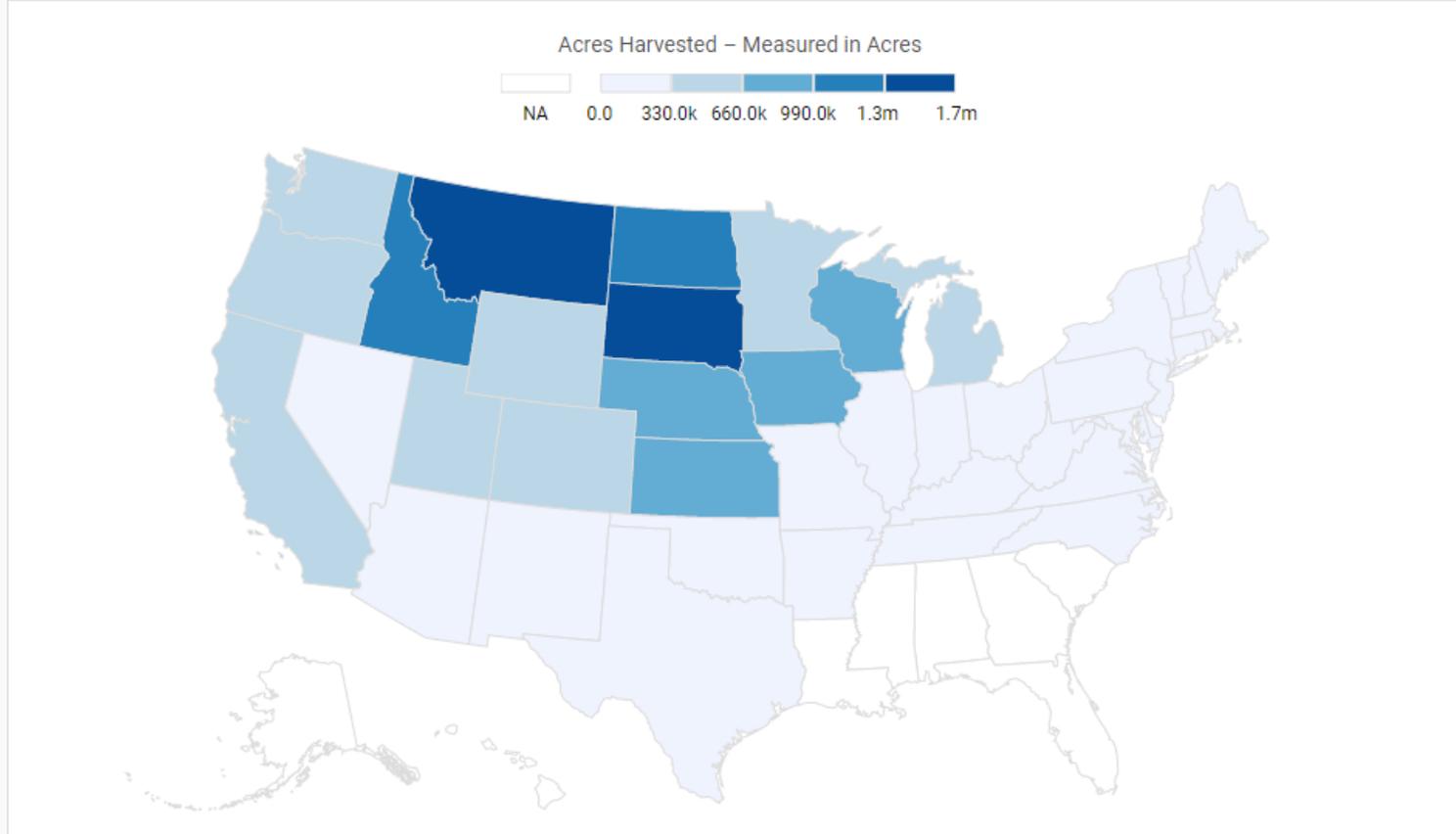
National Alfalfa & Forage Alliance
4630 Churchill Street, #1
St. Paul, MN 55126
651.484.3888
nafa@comcast.net

Source: USDA-NASS 2022



Acres Harvested – Measured in Acres

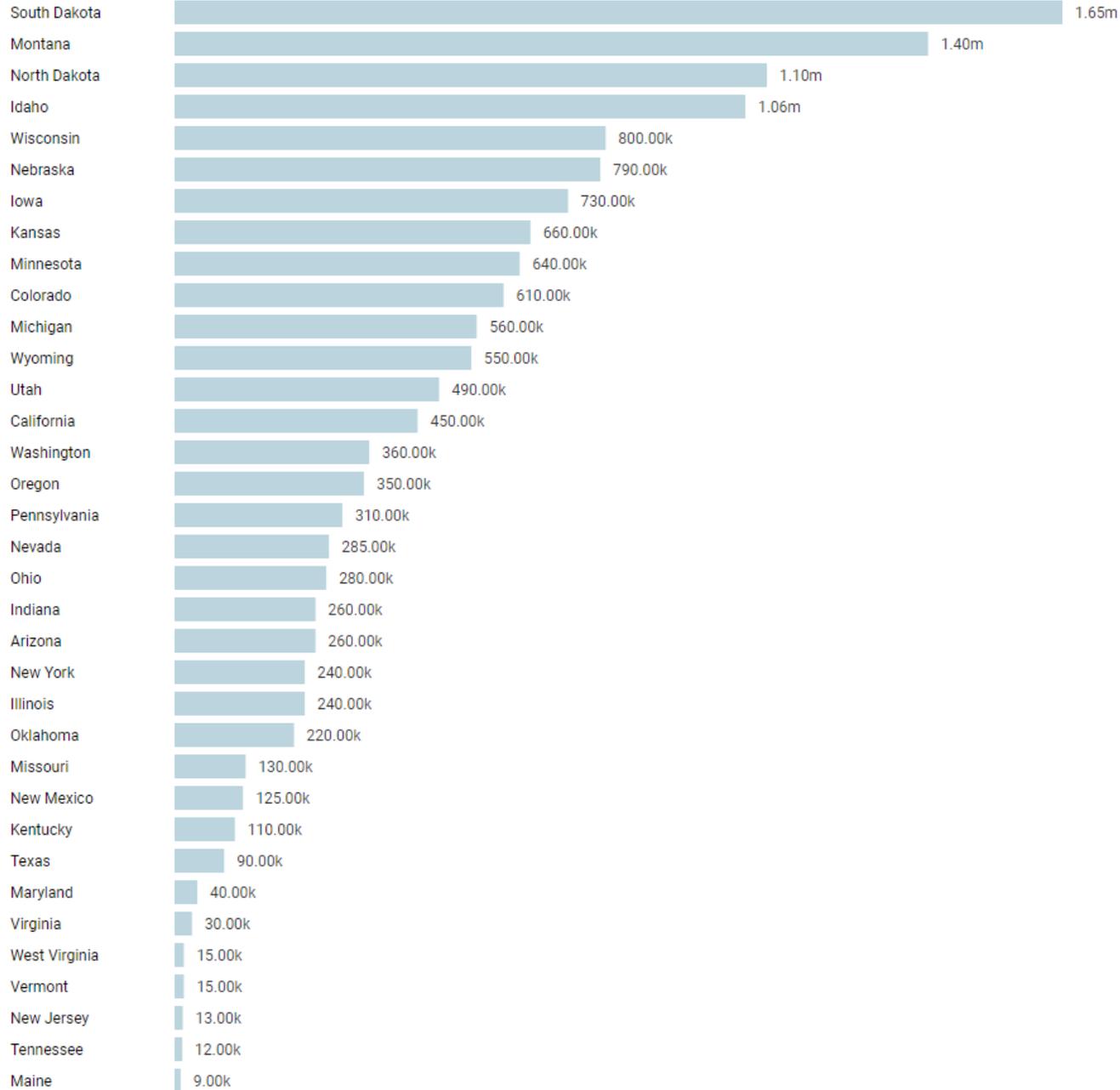
US States – 2022



US State Rankings – 2022
Acres Harvested – Measured in Acres

BY RANK

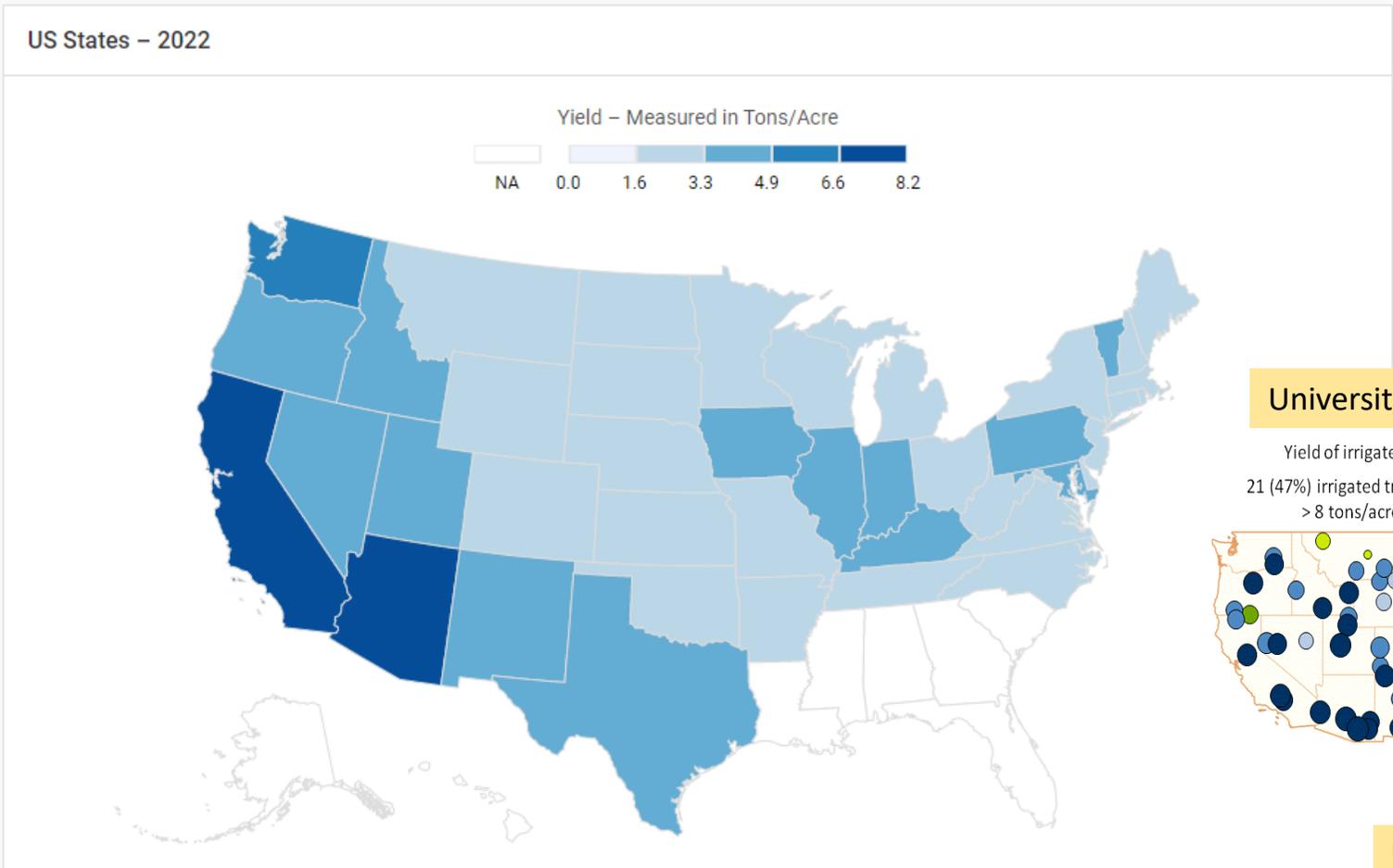
ALPHABETICAL





Alfalfa Yields are generally higher in the irrigated west where it tends to be grown more as a cash crop

But a significant proportion of US alfalfa acres are not managed for high yield

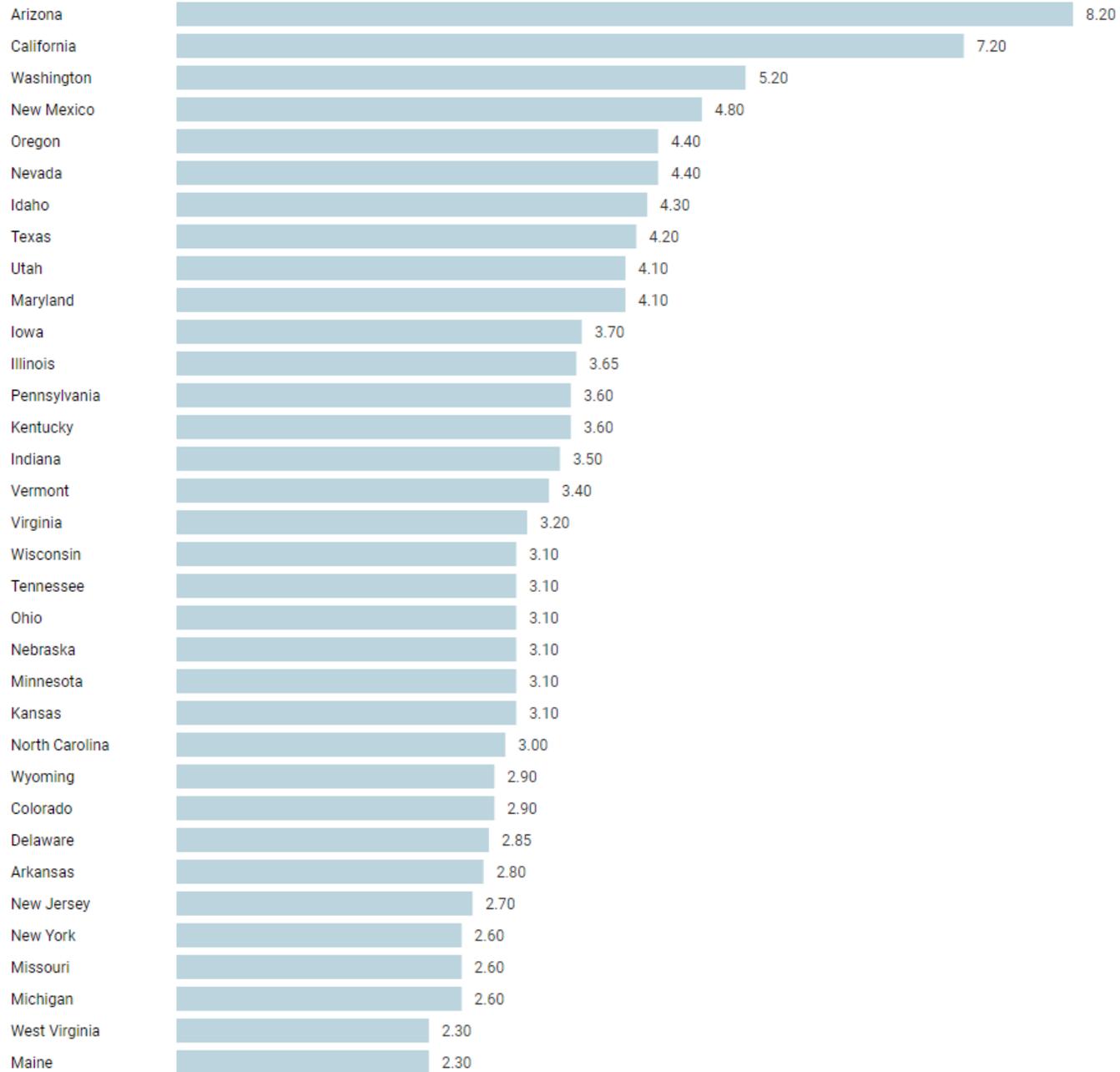


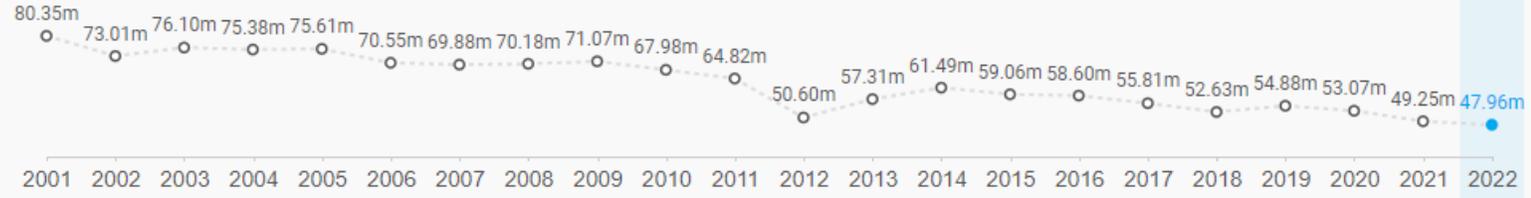
US State Rankings – 2022

Yield – Measured in Tons/Acre

BY RANK

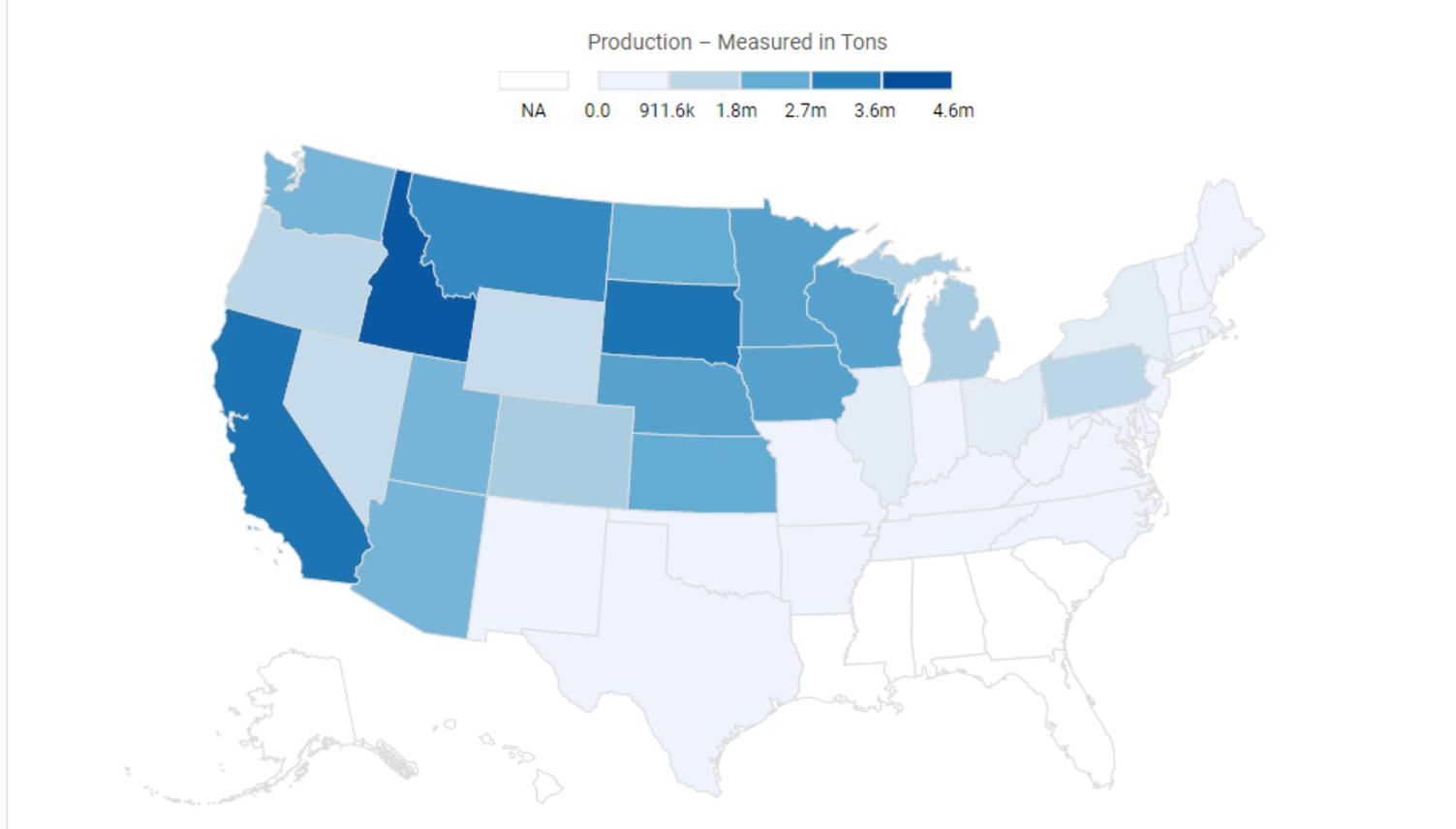
ALPHABETICAL





Production - Measured in Tons

US States - 2022

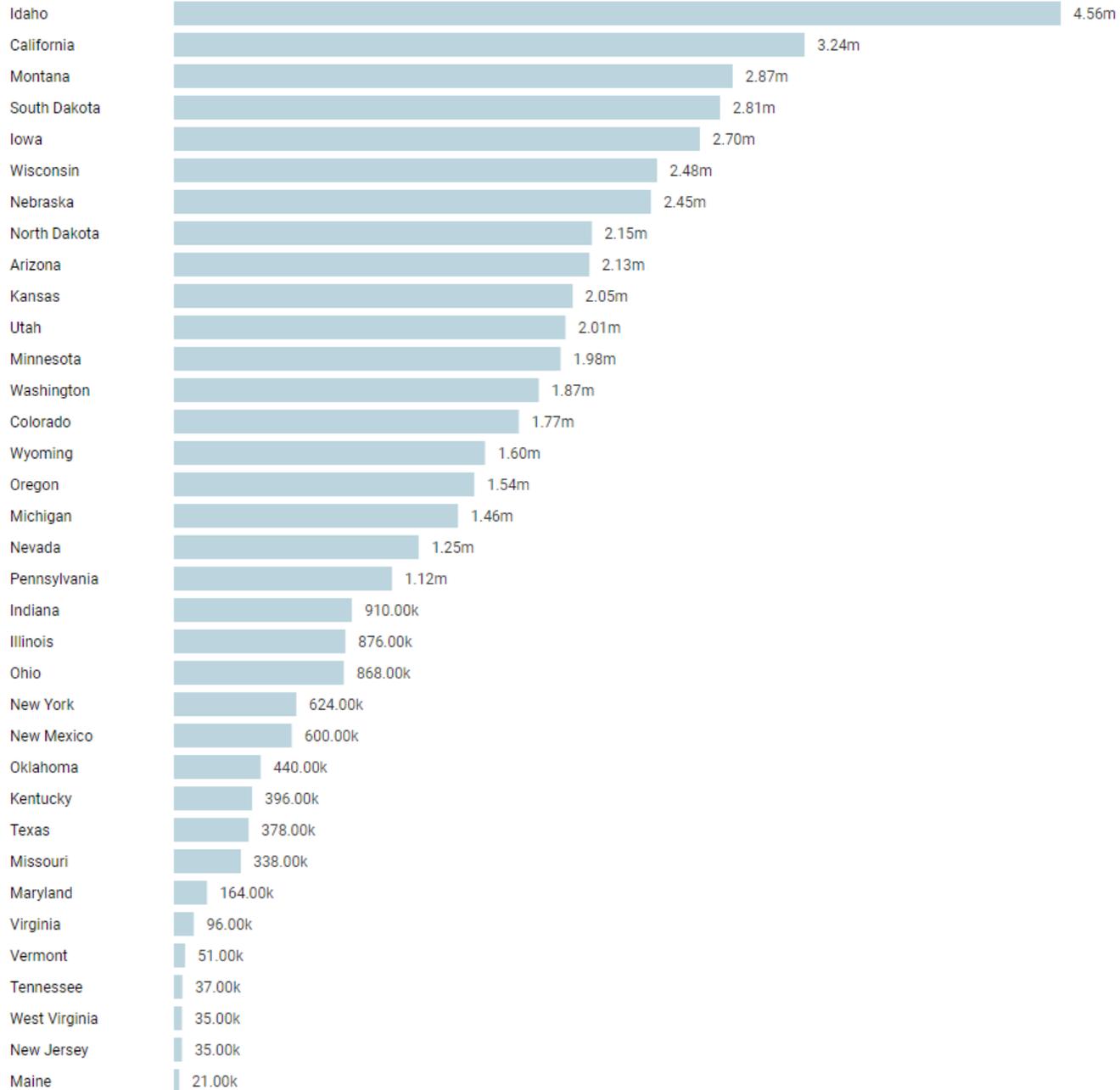


US State Rankings – 2022

Production – Measured in Tons

BY RANK

ALPHABETICAL



2021 Value of Alfalfa Production

\$11.6 billion

National Ranking
State Ranking Among All Field Crops

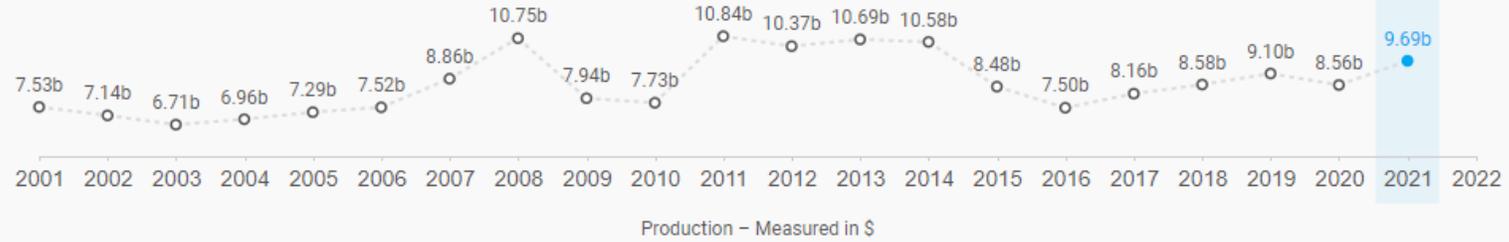


National Alfalfa & Forage Alliance

4630 Churchill Street, #1
St. Paul, MN 55126
651.484.3888
nafa@alfalfa.org

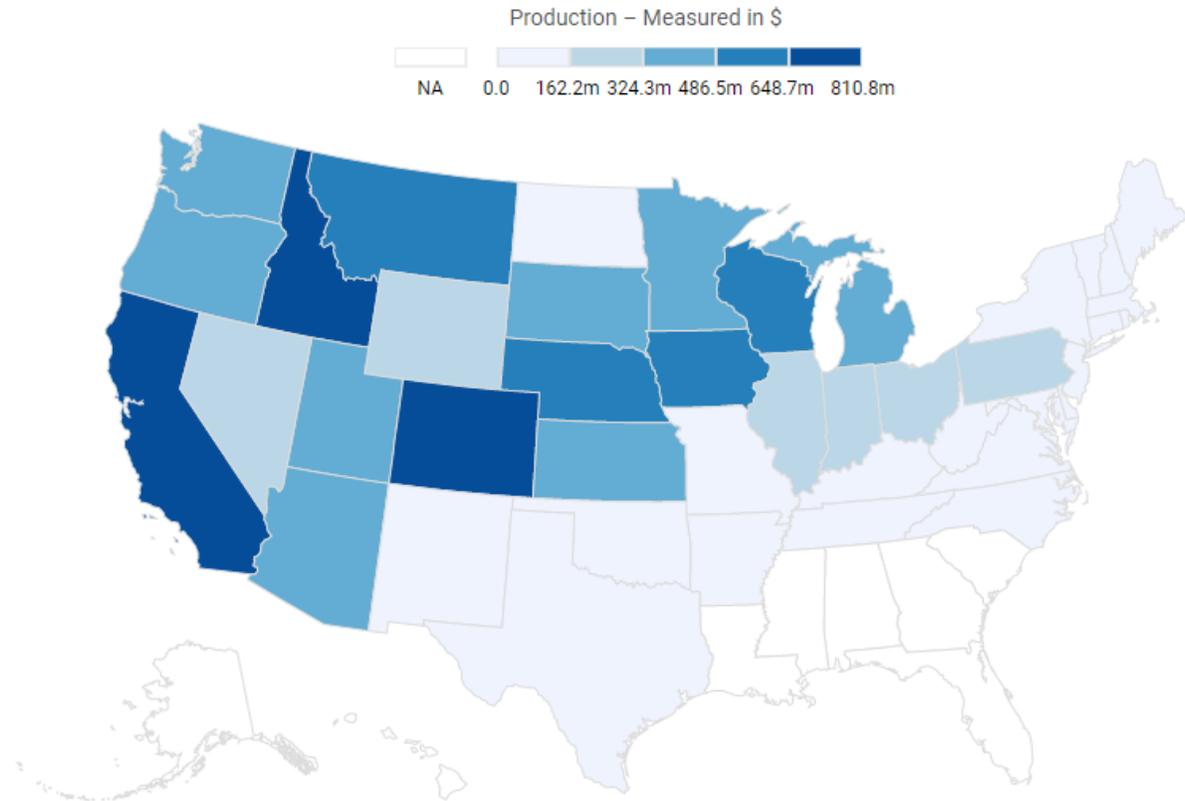
Source: USDA-NASS 2022

(Includes dry hay & haylage for CA, ID, IL, IA, KS, MI, MN, MO, NE, NY, OH, PA, SD, TX, VT, WA, and WI.)



Does not Include Haylage

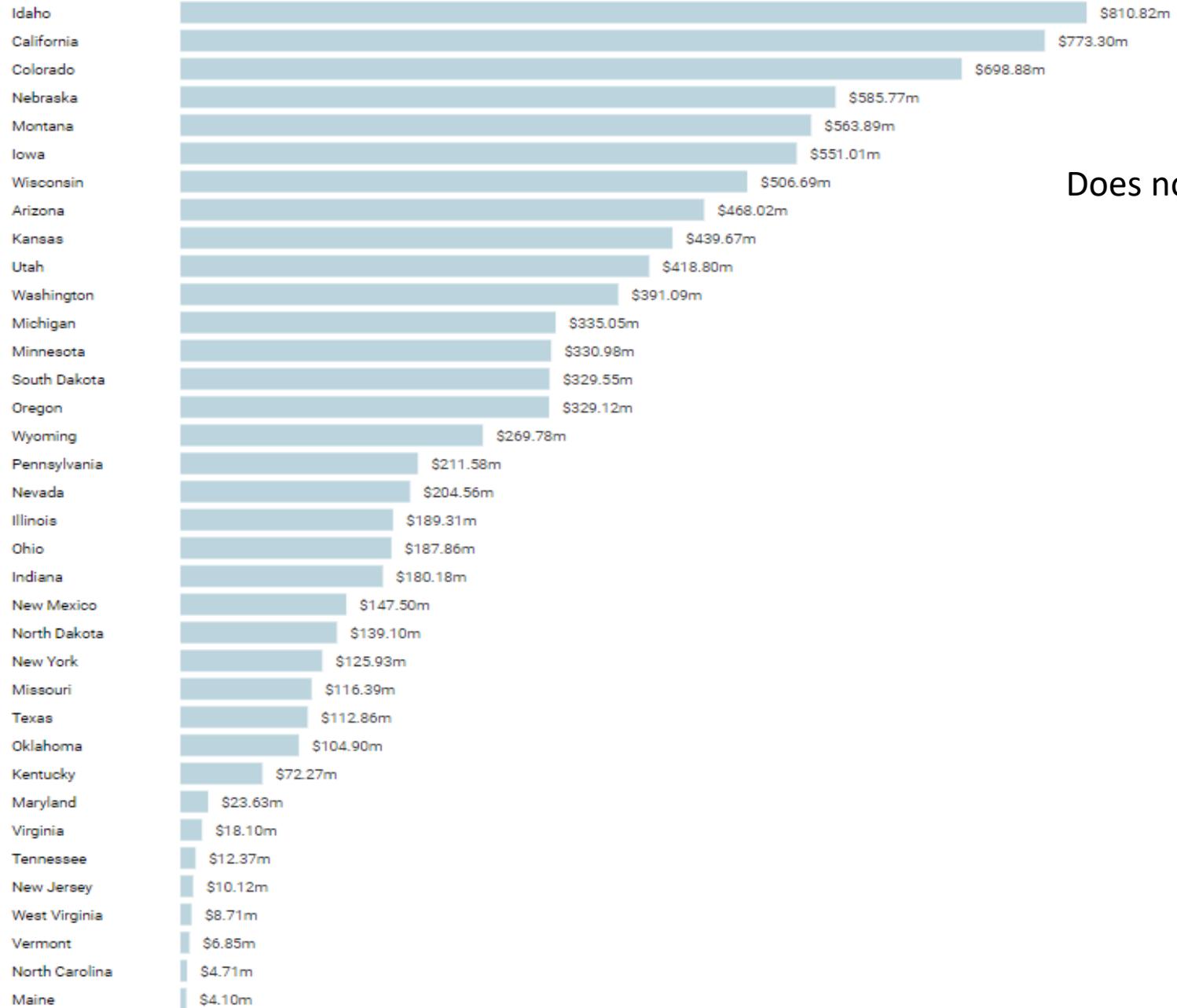
US States – 2021



US State Rankings – 2021
Production – Measured in \$

BY RANK

ALPHABETICAL



Does not Include Haylage

Drought Impact on US Hay Stocks (All Hay)

- Droughts of 2021-2022 coincided with some major US regions of alfalfa production

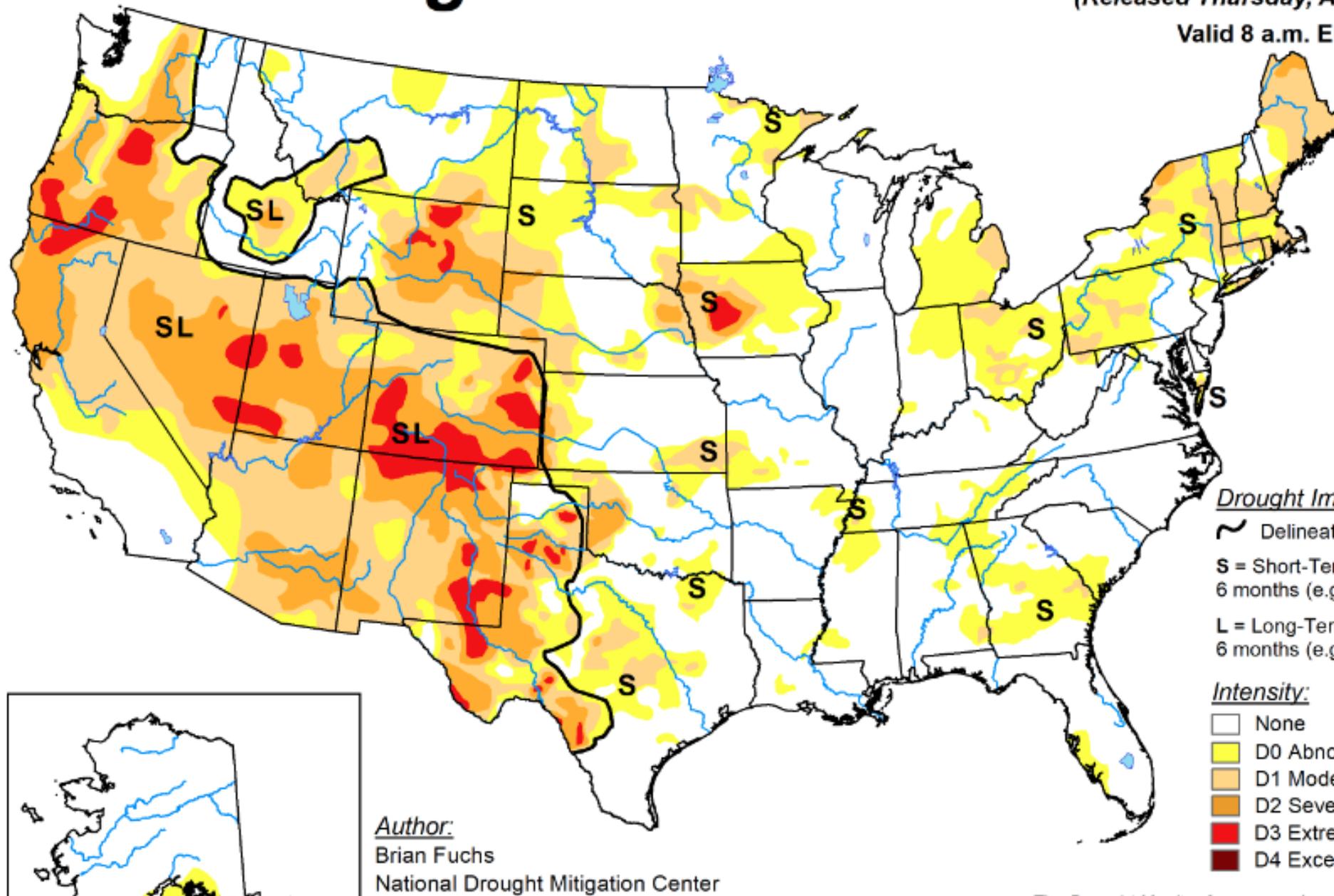
December 1 Hay Stocks are the lowest on record for 70 years

- 71.9 MM tons at Dec 1 2022
- 88.7 MM tons 2010-2019 average
- 106.2 MM tons 2001-2009 average
- 106.6 MM tons 1990-1999 average

U.S. Drought Monitor

August 4, 2020
(Released Thursday, Aug. 6, 2020)

Valid 8 a.m. EDT



Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Author:

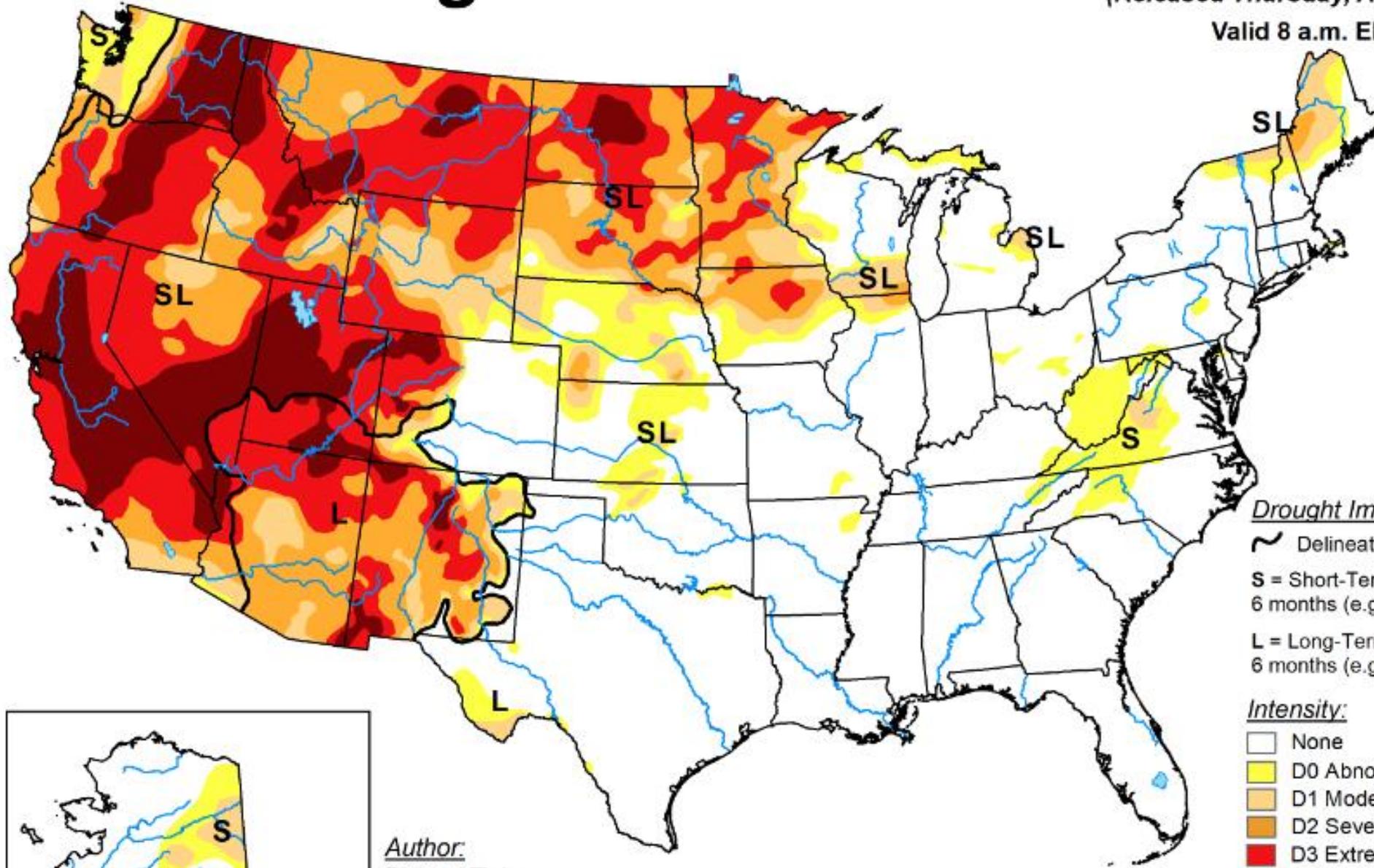
Brian Fuchs
National Drought Mitigation Center

U.S. Drought Monitor

August 3, 2021

(Released Thursday, Aug. 5, 2021)

Valid 8 a.m. EDT



Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

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Author:

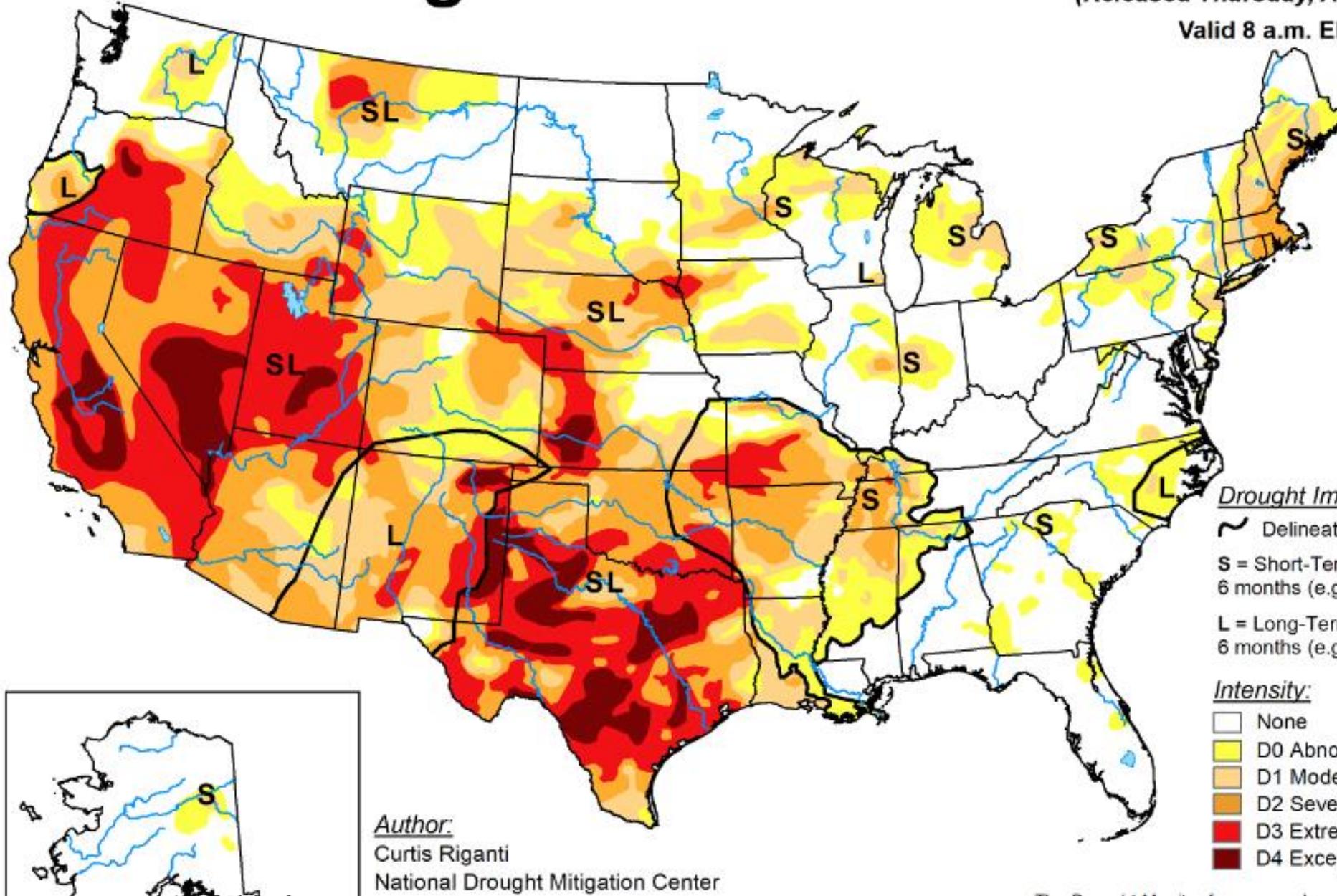
Richard Tinker
CPC/NOAA/NWS/NCEP

U.S. Drought Monitor

August 2, 2022

(Released Thursday, Aug. 4, 2022)

Valid 8 a.m. EDT



Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

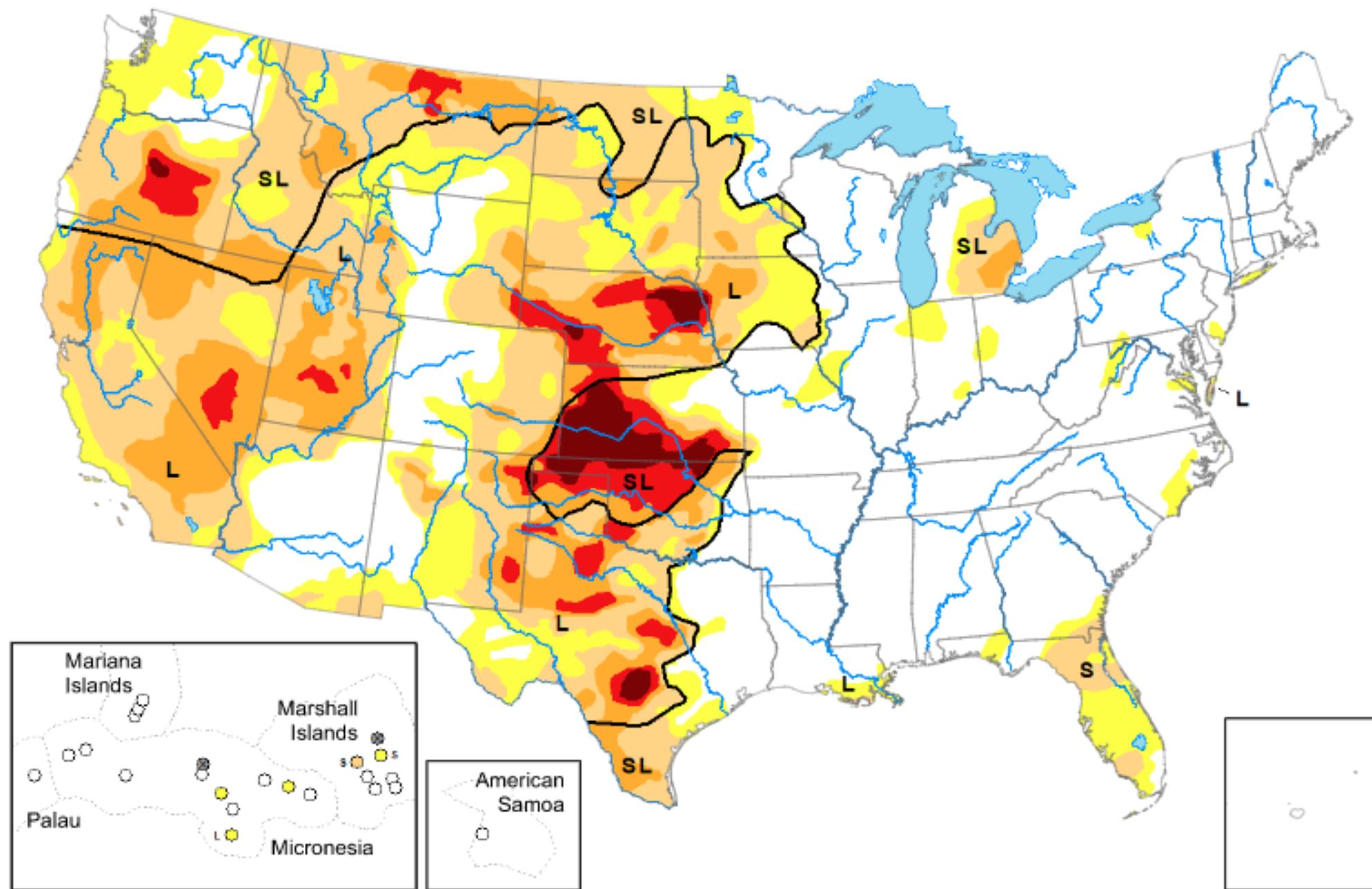
Intensity:

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- D3 Extreme Drought
- D4 Exceptional Drought

Author:

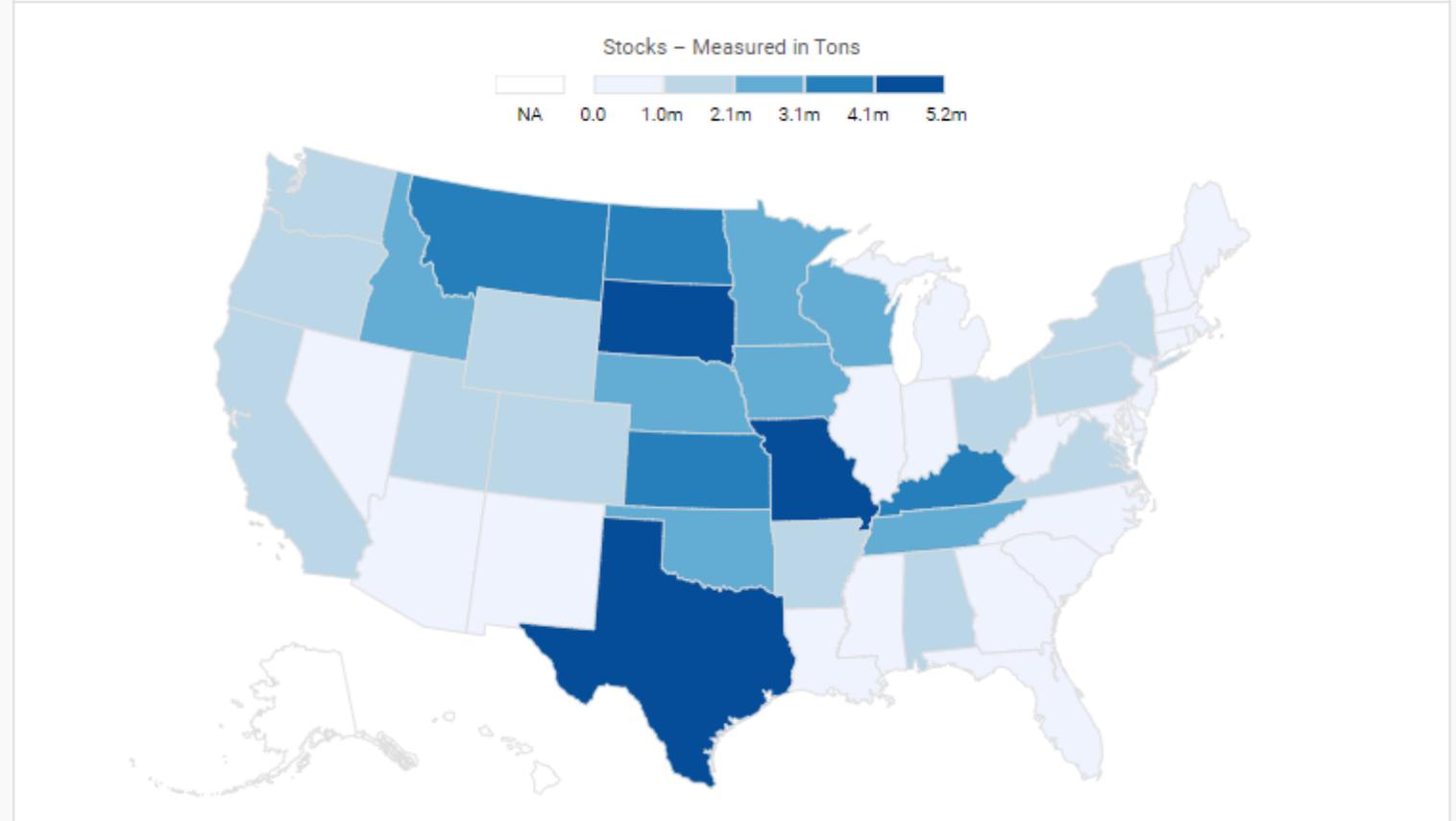
Curtis Riganti
National Drought Mitigation Center

Data valid: February 21, 2023





US States – 2022

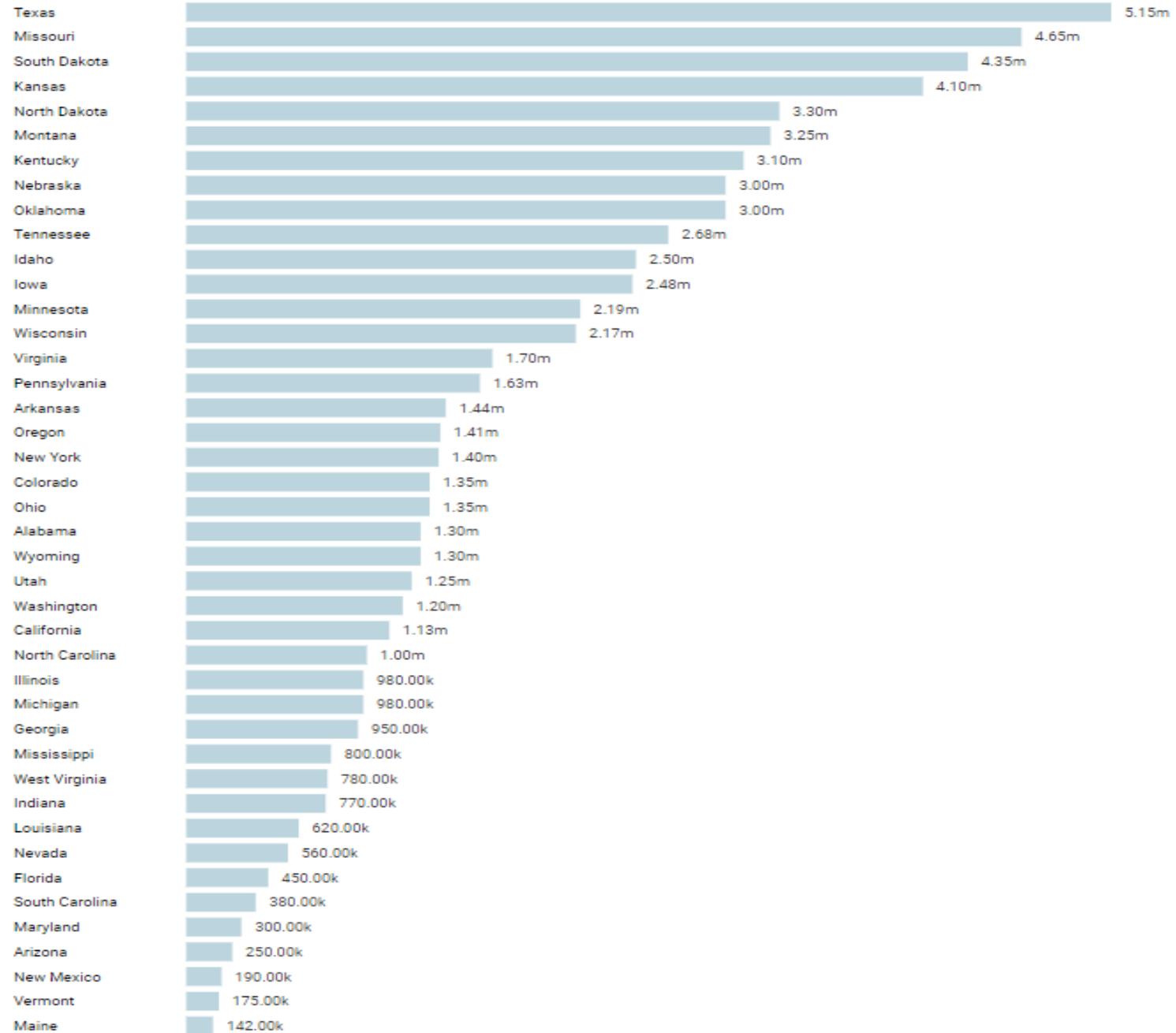


Will 2023 alfalfa and all hay production be sufficient to allow for recovery in hay stocks?

US State Rankings – 2022
Stocks – Measured in Tons

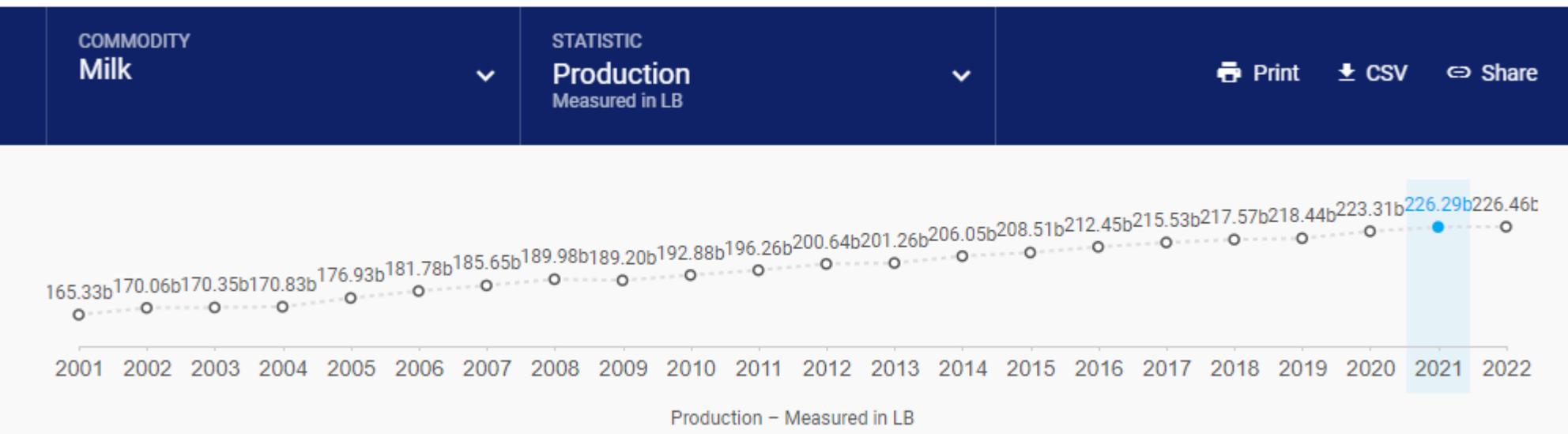
BY RANK

ALPHABETICAL



How is alfalfa used in ruminant feeds?

- Source of digestible fiber for good rumination
 - Stimulates chewing, saliva for rumen buffering, health and function
- Relatively rapid ruminal digestion for good DM intake
- Good mid-protein forage, providing both RDP and RUP
 - Rumen Digestible Protein aids in rumen microbial growth and function
 - Rumen Undigestible Protein or 'bypass' protein for post-ruminal digestion



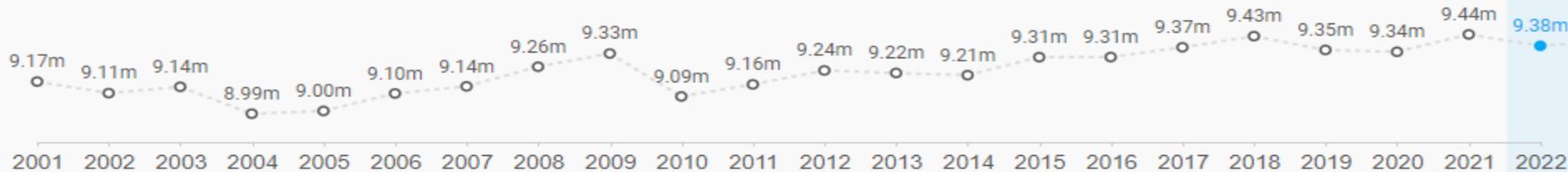
Total Milk Production
Increases 37%
During this 22-Year
Time Series

COMMODITY
Cattle, Cows, Milk

STATISTIC
Inventory
Measured in Head - On Jan 1

Print CSV Share

Dairy Cattle
Increase Just 2%



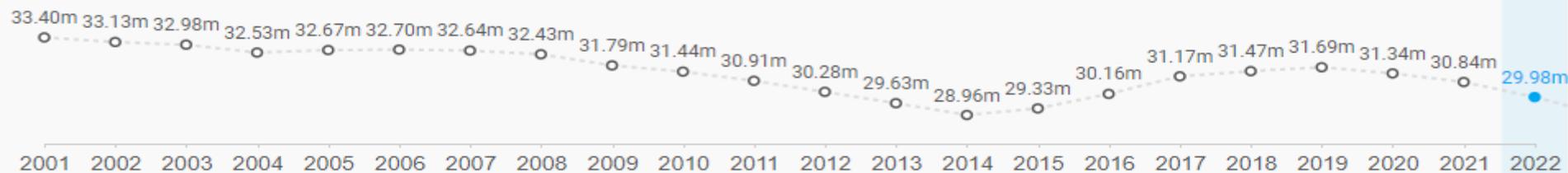
Inventory - Measured in Head - On Jan 1

COMMODITY
Cattle, Cows, Beef

STATISTIC
Inventory
Measured in Head - On Jan 1

Print CSV Share

Beef Cattle
Decline by 11%



Inventory - Measured in Head - On Jan 1

COMMODITY
Cattle, Incl Calves

STATISTIC
Inventory
Measured in Head - On Jan 1

Print CSV Share

For an Overall
5% Decline in
Cattle & Calves



Inventory - Measured in Head - On Jan 1

COMMODITY
Hay (Alfafa)

STATISTIC
Acres Harvested
Measured in Acres

Print CSV Share



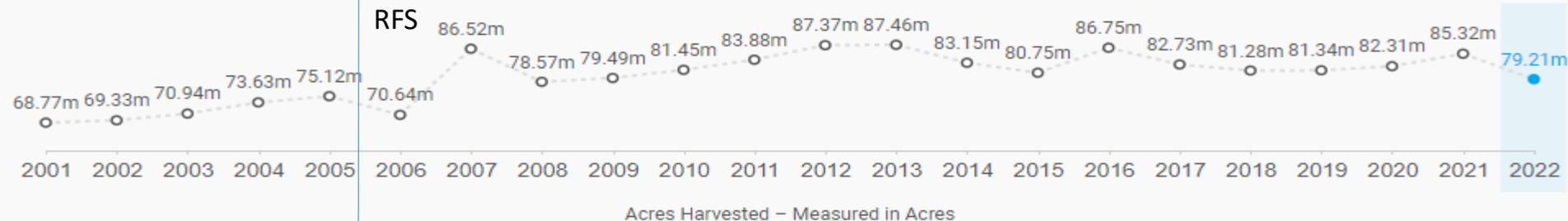
Alfalfa Hay Acres
In Long Term Decline....
Down 38%



COMMODITY
Corn, Grain

STATISTIC
Acres Harvested
Measured in Acres

Print CSV Share



Corn Acres
Get a Boost from RFS
Up 15-18%

COMMODITY
Soybeans

STATISTIC
Acres Harvested
Measured in Acres

Print CSV Share



Soybean Acres
Trend Up Too
Increasing 18%

Why is Alfalfa Acreage Declining ?

- Alfalfa Acres and Production are not tracking cattle inventory
- Competition for alfalfa acres versus Title 1 Crops
 - Inadequate farm safety net for alfalfa versus Title 1 Commodity Crops
 - Price discovery is regionalized versus CBOT for Commodity Crops
- Increasing mid-protein by-products available for feeding (RFS 2005)
- Industrialization and ongoing consolidation of the dairy industry
- Competition for water resources in irrigated agriculture
- Increasing yield productivity of competing crops

COMMODITY
Hay (Alfafa)

STATISTIC
Yield
Measured in Tons/Acre

Print CSV Share



Alfalfa Hay Yields
Remain Static



COMMODITY
Corn, Grain

STATISTIC
Yield
Measured in Bushels / Acre

Print CSV Share

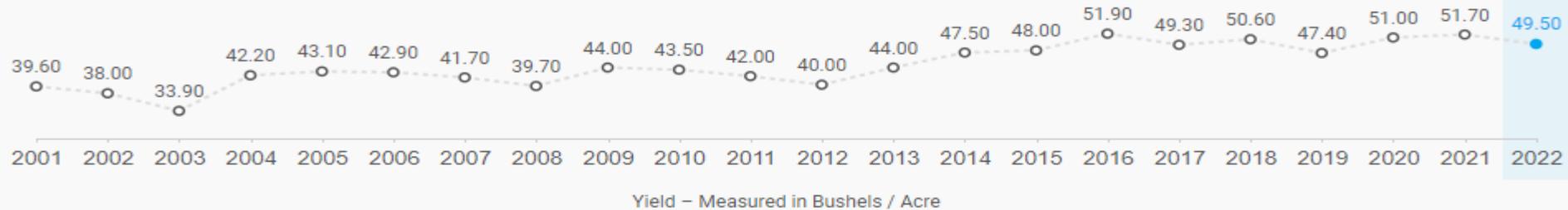


Corn Grain Yields
March Upward
Increasing 25%

COMMODITY
Soybeans

STATISTIC
Yield
Measured in Bushels / Acre

Print CSV Share



Soybeans Take the
Yield Improvement
Prize, Up 33%

COMMODITY
Hay (Alfafa)

STATISTIC
Production
Measured in Tons

Print CSV Share



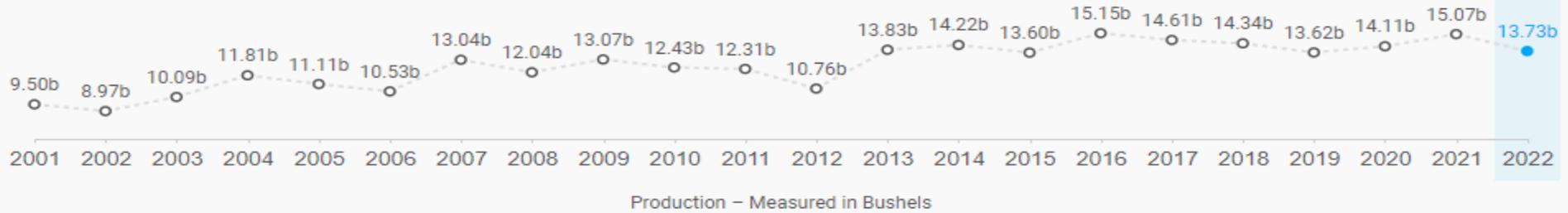
Total Alfalfa Production Declines in Lockstep With Acreage Trend 40% Drop



COMMODITY
Corn, Grain

STATISTIC
Production
Measured in Bushels

Print CSV Share



Total Corn Grain Production Increases 44%

COMMODITY
Soybeans

STATISTIC
Production
Measured in Bushels

Print CSV Share



Total Soybean Production Increases 45%

Why is Alfalfa Acreage Declining ?

- Industrialization and ongoing consolidation of the dairy industry
 - Concentrated ratio of cattle / acres incentivizes corn silage
 - Increased concentration of manure on fewer acres necessitates manure management
 - Manure N utilization helps offset corn crop input cost
 - One annual harvest for corn silage versus multiple harvests for alfalfa
 - Increasing corn silage yield over time, increasing DM/Acre

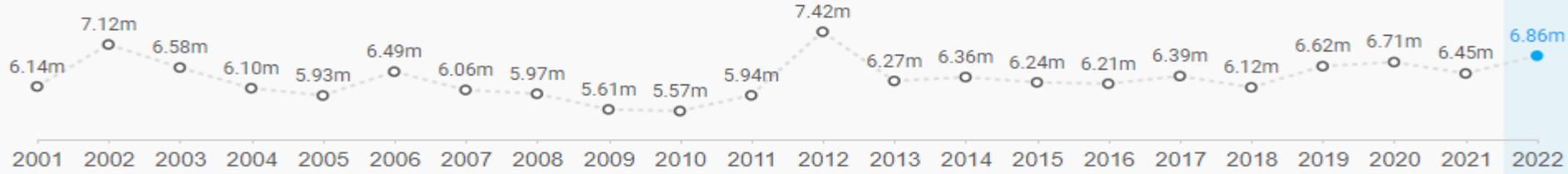
COMMODITY
Corn, Silage



STATISTIC
Acres Harvested
Measured in Acres



Print CSV Share



Acres Harvested – Measured in Acres

Corn Silage Acres Slightly Increasing

COMMODITY
Corn, Silage



STATISTIC
Yield
Measured in Tons / Acre



Print CSV Share



Yield – Measured in Tons / Acre

Corn Silage Yield Increased 11% to a Stable Level

COMMODITY
Corn, Silage



STATISTIC
Production
Measured in Tons



Print CSV Share



Production – Measured in Tons

Corn Silage Total Production Trends Up 29%

COMMODITY **Hay (Alfafa)** STATISTIC **Acres Harvested**
 Measured in Acres

Print CSV Share

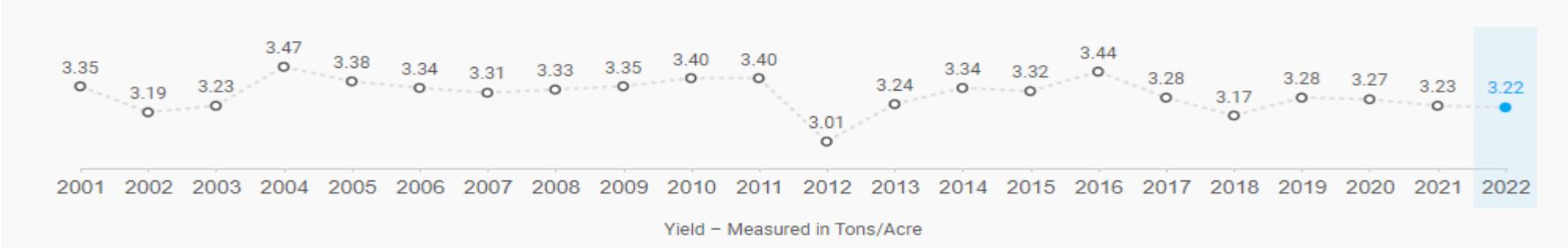


Alfalfa Hay Acres
 In Long Term Decline....
 Down 38%



COMMODITY **Hay (Alfafa)** STATISTIC **Yield**
 Measured in Tons/Acre

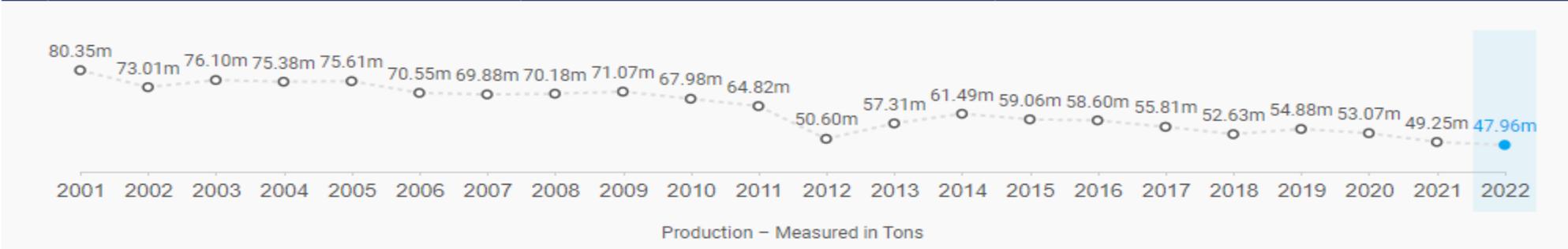
Print CSV Share



Alfalfa Hay Yields
 Remain Static

COMMODITY **Hay (Alfafa)** STATISTIC **Production**
 Measured in Tons

Print CSV Share

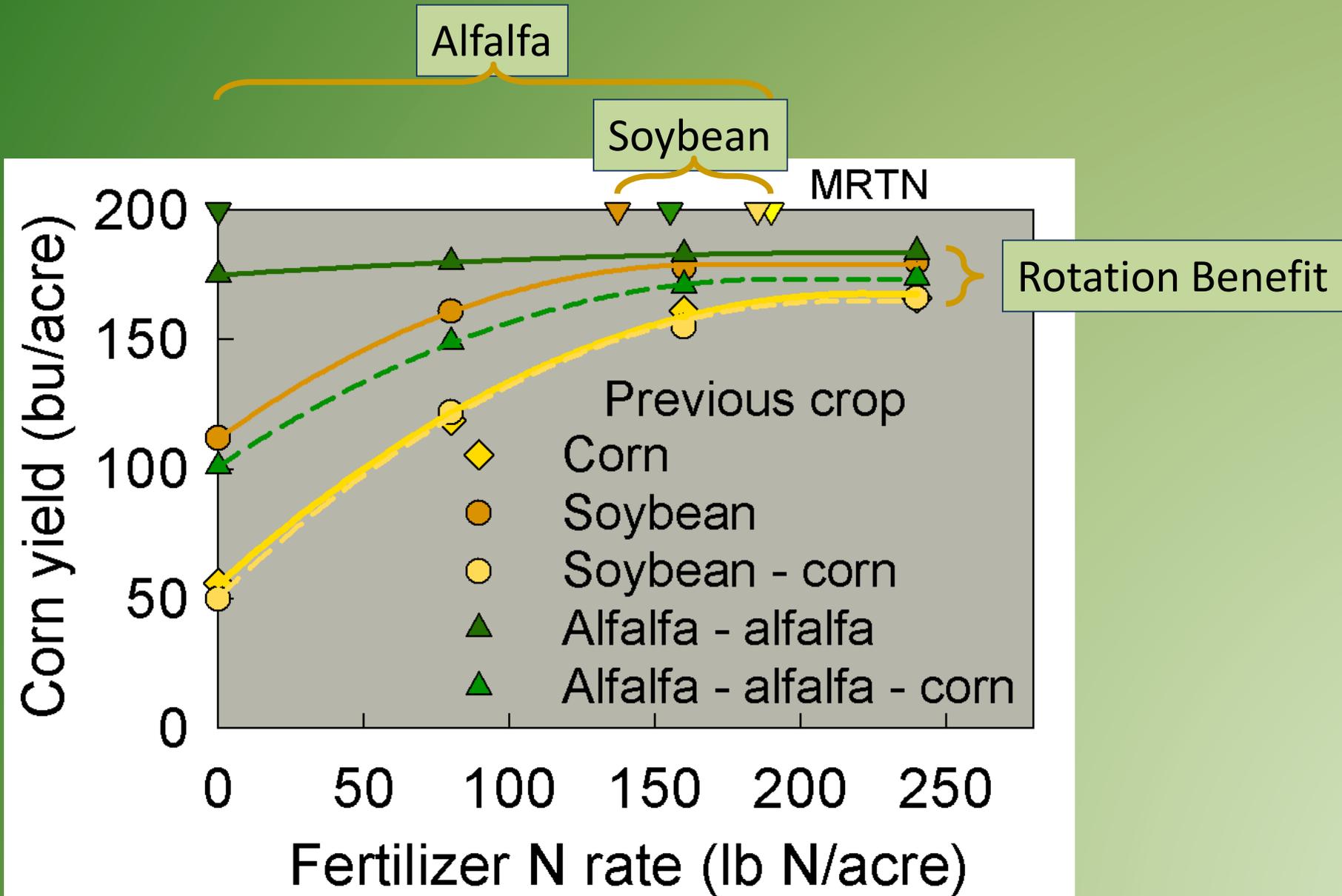


Total Alfalfa Production
 Declines in Lockstep
 With Acreage Trend
 40% Drop

Benefits of Alfalfa on the Ag Landscape

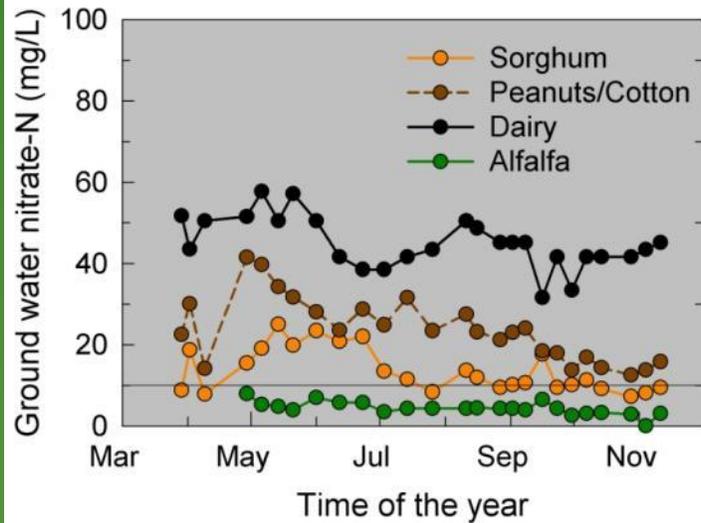
- Alfalfa is the best legume for providing Nitrogen benefits to following crops in rotation
- Alfalfa confers benefits to following crops in other ways as well
- Increased soil microbial activity
- Increased soluble N capture; reduces leaching
- Alfalfa as a perennial crop slows or stops run-off from erodible lands
- Alfalfa can tolerate drought and salinity levels not tolerated by most other crops
- Alfalfa provides soil health benefits for sustainability

Fertilizer N replacement value (N credit)



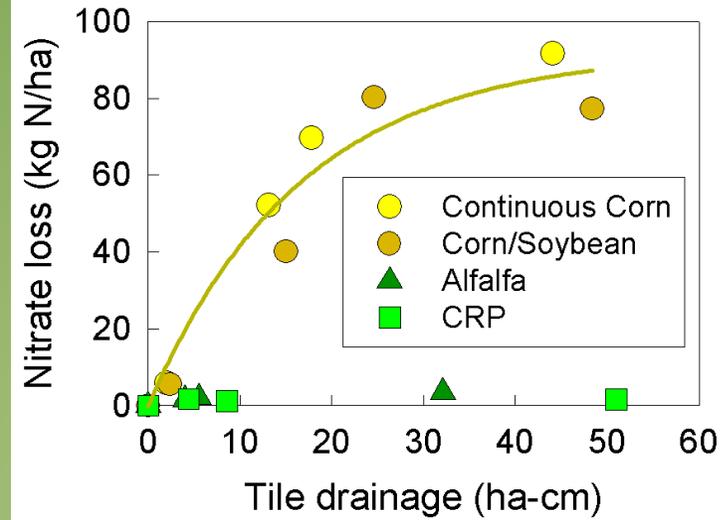
Vigorous stands of alfalfa reduce nitrate leaching

Ogallala aquifer



Taylor and Bigbee, 1973. Water Res. 7:1155

Tile drain losses



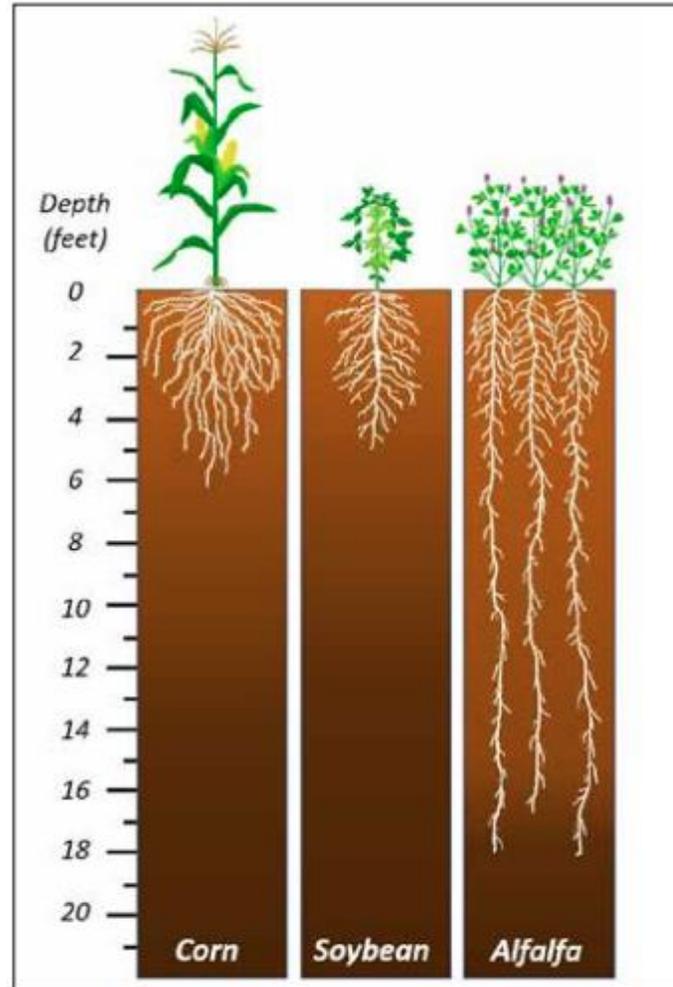
Randall et al., J. Environ. Qual. 26:1240

Nitrate leaching requires

- 1) excess water
- 2) nitrate

Soil Health Benefits

Drought and Salinity Tolerance



Alfalfa roots commonly extend up to 16 feet into the soil, much deeper than other crops. The deep root system holds soil in place and creates channels that promote water infiltration, biological activity in the root zone, and improved nutrient cycling.

- Alfalfa develops very deep roots that make channels into subsoil for better soil air and water infiltration
- Deep alfalfa root mass promotes soil microbial activity
- Alfalfa can access subsoil moisture and nutrients to maintain production under drought
- Alfalfa can enter a dormant period for up to a year during extreme drought and soil moisture depletion
- Alfalfa can be grown in saline soil conditions
- Alfalfa can tolerate moderately saline irrigation when most other crops cannot

Alfalfa confers benefits to following crops in rotation

Table 2. Microbial three-year alfalfa and corn at Russell Ranch. biomarkers measured with phospholipid fatty acid analysis, following {corn compared to following alfalfa}

System	Total Microbial Biomass µg/g soil	Mycorrhizal Fungi Biomarkers µg/g soil	Microbial N µg/g soil	Total Dissolved Nitrogen µg/g soil
Alfalfa-Tomato	43.3	1.6	5.0	9.4
Corn-Tomato	31.1	1.1	1.7	23.5

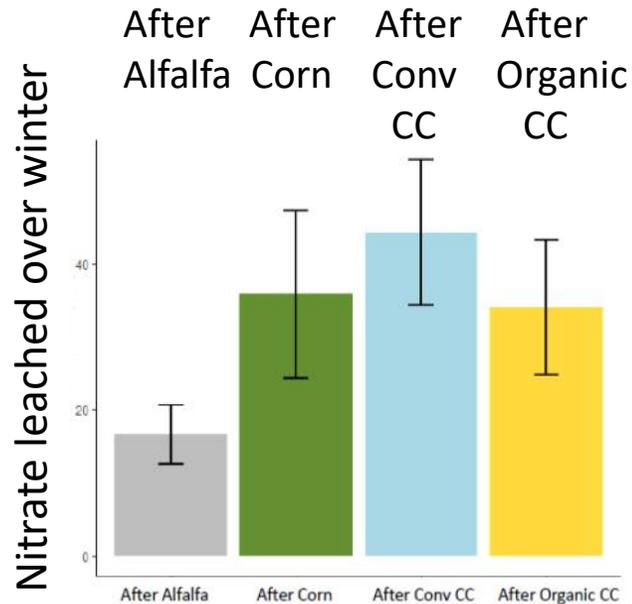


Figure 4. (Left) Nitrate leached over the winter season following three-year alfalfa, conventional corn, cover crops following conventional corn, and cover crops following organic corn with compost over the 2018-19 winter season at Russell Ranch. **(Right)** Ion-exchange resin bag being installed under the alfalfa soil profile.

- Increased microbial N to benefit following crops
- Increased microbial biomass for increased soil tilth and productivity
- Reduced levels of dissolved soil Nitrogen
- Nitrate leaching significantly reduced

CHARACTERIZING THE BENEFITS OF ALFALFA IN ROTATION & COMMUNICATING VALUE OF ENVIRONMENTAL SERVICES TO THE PUBLIC

Nicole Tautges, Emily Woodward, and Dan Putnam¹

Top 10 Markets for Hay in 2022

Export Hay

Total Export Value

\$1.66 Billion

Total Volume (Millions)

4 Metric Tons

3-Year Average

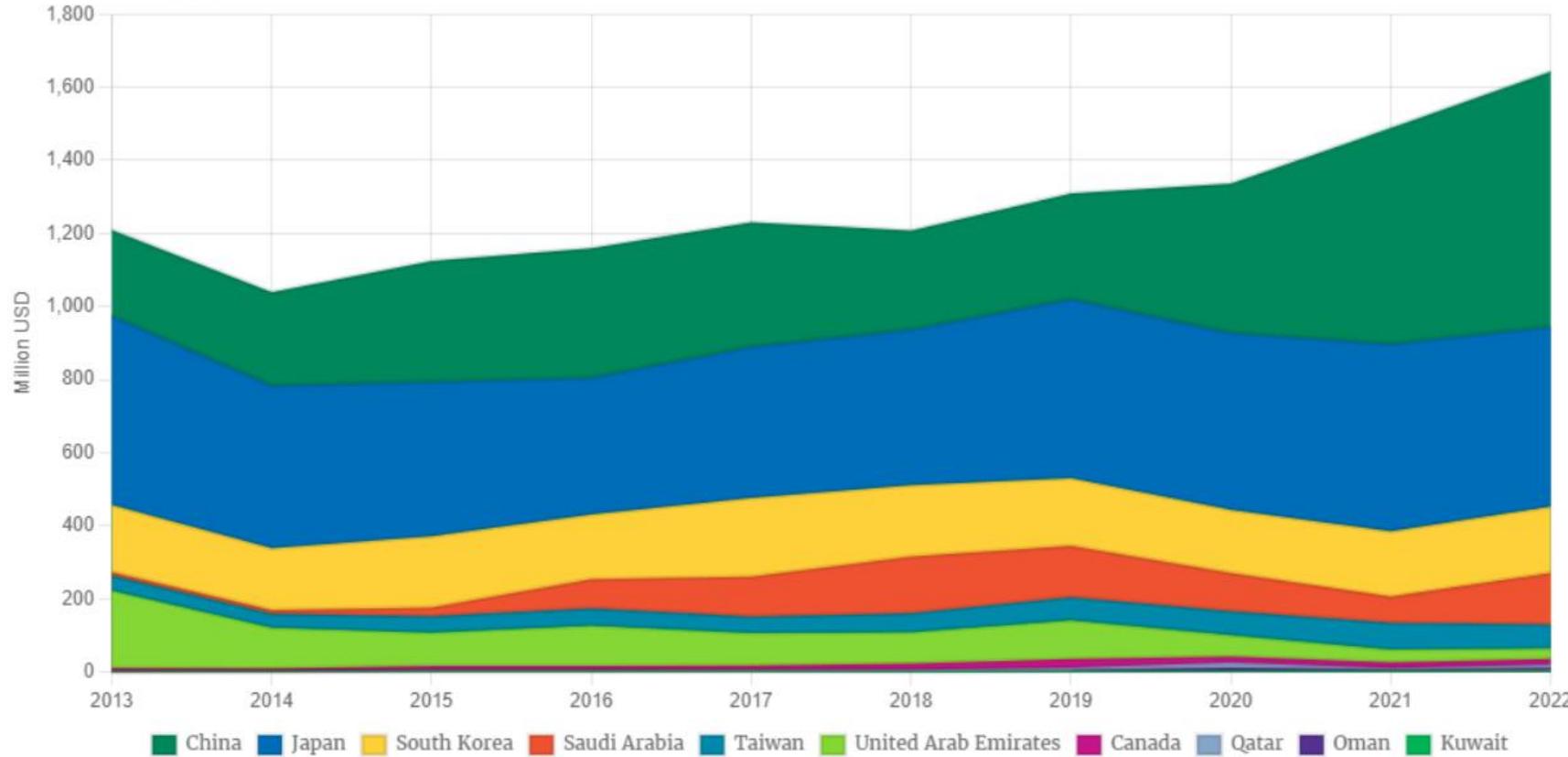
\$1.51 Billion

Compound Average Growth

3.1% (2013-2022)

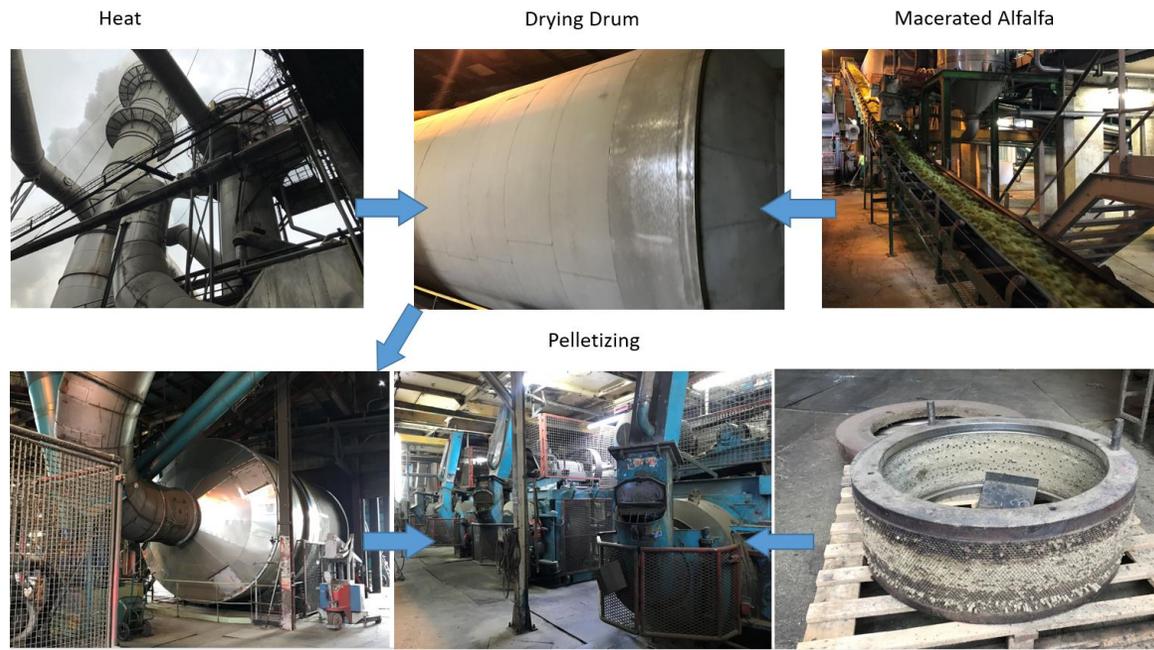
Market	Total Value (USD)
China	\$698.78 Million
Japan	\$492.15 Million
South Korea	\$182.24 Million
Saudi Arabia	\$140.55 Million
Taiwan	\$65.05 Million
United Arab Emirates	\$28.87 Million
Canada	\$16.52 Million
Qatar	\$8.47 Million
Oman	\$6.09 Million
Kuwait	\$4.83 Million

Top 10 Hay Export Markets 2013 - 2022



Other uses on the horizon?

- Alfalfa processing is minimal compared to grain crops, but has good potential for protein extraction, leaf meal, and fiber/biomass
- High quality alfalfa protein can be extracted to supplement various feeds with less fiber fraction
- Remaining fiber has value for ruminant feed and for biofuel or biogas production



How might climate change impact alfalfa?

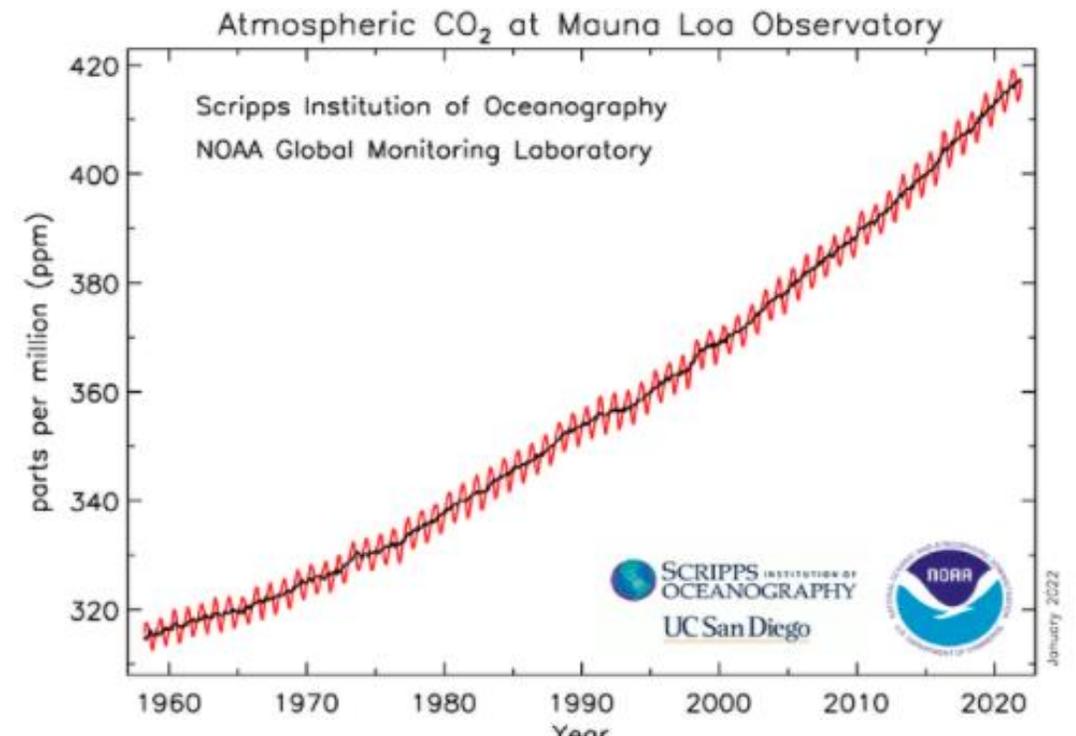
- Lengthening growing seasons provide more cumulative solar radiation during the growing period, and more time for crop growth and yield accumulation
- Increasing atmospheric CO₂ also increases photosynthesis rate
- C4 plants are more responsive than C3 plants

Climate and agronomy, not genetics, underpin recent maize yield gains in favorable environments

Gonzalo Rizzo <https://orcid.org/0000-0001-5753-3869>,

Juan Pablo Monzon <https://orcid.org/0000-0001-6992-1842>,

*Fatima A. Tenorio <https://orcid.org/0000-0001-9836-3878>, +2,
and Patricio Grassini*



NIFA's *Alfalfa Seed & Alfalfa Forage Systems Research Program (ASAFS)*

Research Priorities	
ASAFS	NAFA's Alfalfa Checkoff
Increase alfalfa forage and seed yields and forage quality through improved management practices, plant breeding, and other strategies to reduce biotic and abiotic stresses and costs of production.	Feed Value Consistency (i.e., harvest, storage, digestibility, sampling)
Improve alfalfa forage and seed harvest and storage systems, including automation that reduces labor costs, to optimize economic returns to alfalfa producers as well as end-users including milk producers.	Forage Quality Improvements
Develop methods to estimate alfalfa forage yield and quality to support marketing as a livestock feed and instruments to reduce producer risks.	Market Development
Explore new uses for alfalfa such as in fish feeds, nutritive supplements, alternative protein sources for human consumption, high-value chemical manufacturing, or other novel uses.	Yield Improvements
Develop improved insect, disease and weed management strategies, including spotted aphid in alfalfa seed production and potential herbicide carry-over issues.	NAFA Publications Update -Alfalfa Analyst, Alfalfa Germination and Growth
Document the contribution of alfalfa production systems to climate-smart agriculture, including the sequestration of carbon.	



Support the Alfalfa Checkoff!
Buy your seed from these facilitating marketers:

Alfalfa Partners - S&W
 Alforex Seeds
 America's Alfalfa Channel
 CROPLAN
 DEKALB
 Dyna-Gro
 Fontanelle Hybrids
 Forage First
 FS Brand Alfalfa
 Gold Country Seed
 Hubner Seed
 Invictis Seed Solutions
 Jung Seed Genetics
 Kruger Seeds
 Latham Hi-Tech Seeds
 Legacy Seeds
 Lewis Hybrids
 NEXGROW
 Pioneer
 Prairie Creek Seed
 Rea Hybrids
 Specialty
 Stewart
 Stone Seed
 W-L Alfalfas



US Alfalfa Market Recap and Drivers

- Increasing dairy size leads to more purchased feeds and fewer home-grown forages in dairy rations
- Many dairies are feeding less and less alfalfa, offsetting purchased alfalfa hay with DDGS and other by-product commodities.
- Continuing long-term trend of less alfalfa and more corn silage in dairy diets
- Farms in livestock areas gravitate to Title 1 crop production over alfalfa production
- *Alfalfa acreage declines represent a loss of the sustainability benefits of keeping alfalfa in production ag*
- *Ten million acres of lost alfalfa production in just over two decades*
- **Bottom Line: Alfalfa must compete for acres with other crops, especially corn with the high research investment in productivity**
- **Productivity matters, in fact it is essential for long-term footprint of alfalfa on the production ag landscape**
- **So our job is to make alfalfa a more productive crop, through yield improvement and better agronomic and harvest management on farms**

